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Information sharing in supply chains: an overview

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Abstract

Information sharing and technology is the one of the key aspects of coordination amongst parties in a supply chain. Supply chain efficiency is highly important as today's competition is no longer between companies, but between supply chains. Information sharing can increase supply chain efficiency by reducing inventories and smoothing production. This paper provides an overview about information sharing in supply chains. The paper discusses the impacts of information sharing in supply chains along with the associated benefits. Challenges posed in the process of information sharing are also listed out.

Keywords: Supply chain management. Information sharing

1. Introduction

Supply chain management (SCM) is related to the co-ordination of products and information flows among suppliers, manufacturers, distributors, retailers, and customers. By sharing information between suppliers and retailers appropriately and co-coordinating their replenishment and production decisions under demand uncertainty, it is possible to reduce costs and improve customer service levels.

During the past 10 years, supply chain management and information technology management have attracted much attention from both practitioners and researchers. As information technology evolves, firms tend to become more integrated. Therefore, integrating effective supply chain practice with effective information sharing becomes critical for improving supply chain performance.

Information sharing is an important component of cooperation in SCM. It can be categorized according to operations areas such as inventory, sale, demand forecasting, order state, and production plan.

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Looking at the information flow direction, the inventory and production plan related information is a two-Looking at the information flow direction, the inventory and production plan related information is a two way communication between the downstream and upstream organizations on the supply chain. The sale information and demand forecasting information are the flows from downstream companies to their upstream partners. The order state information is provided by upstream organizations to their downstream partners. In addition, information sharing also includes performance criteria, such as production quality data and early complete date, etc. and production capacities among the partners. The information sharing is often supported by an electronic data interchange, internet and other communication devices between the partners.

Information sharing in supply chain context refers to the extent to which crucial and/or proprietary information is available to members of the supply chain. Shared information can be tactical (e.g. purchasing, operations scheduling, logistics) or strategic (e.g. long-term corporate objectives, marketing, and customer information). Prior research on the importance of formal and informal information sharing between trading partners has shown that effective information sharing enhances visibility and reduces uncertainty [12]. It allows firms to access data across their supply chains, allowing them to collaborate in activities such as sales, production, and logistics. The extent to which information is shared can create opportunities for firms to work collaboratively to remove supply chain inefficiencies, and thus has a significant direct impact on the relationship between the buyer and the supplier. The ability to access important information across the supply chain can also provide other opportunities. For example, when additional supply chain information becomes available, firms can take advantage of this increased visibility to modify existing actions or plan future operations.

The major research questions in the context of deployment of information sharing in supply chain management include:

- With whom should information be shared?
- What information should be shared?
- What are all the challenges posed in the process of information sharing?

This paper attempts to make an overview of these issues.

2. Information sharing in supply chains

In the market with rapidly shrinking product life cycles, firms must continuously find new ways to design and deliver high-quality products and services in a timely manner. Inadequate or insufficient information sharing limits a firm's ability to leverage otherwise supportive relationships to accomplish this. Moreover, rapid advances in technology and global information infrastructure mean that firms and their supply chain partners must possess appropriate, competitive inter-organizational information systems if they are to maintain the ability to respond quickly and effectively to changing customer needs and expectations [5].

First, how far information should be shared both upstream and downstream in a supply chain? And which partners at each stage should be involved? These decisions are related to the structure of supply chain [9]. Supply chain structure is how companies are arranged to form a supply chain and how all activities are linked [22,23]. An individual company can participate in a number of supply chains [30]. As pointed by Cooper et al. [7] companies need to determine carefully with which partners of supply chains

they should be closely integrated. Cooper et al. also point out that level of integration depends on various factors including firm capabilities, the complexity of products, and corporate culture.

As information sharing is the foundation of supply chain integration, decisions on the level of integration are strongly correlated with decisions on what information should be shared and how it should be shared. Cooper et al. [7] contend that designing the configuration of the supply chain is not merely determining with whom companies should integrate but also designing how a company's activities are linked to those of their partners and deciding what information should be made accessible by partners.

One approach is to consider how many stages up and down the supply chain should company share information with. This is particularly important as the implementation of information sharing is not costless [27] and may require significance changes in companies' business operations. Researchers [10,20] have examined various combinations of sharing between stages in a supply chain comprising a manufacturer, two distributors, and two retailers. Four combinations of sharing demand and inventory levels were studied: no information sharing; sharing demand and inventory level between retailers and distributors only; distributors and the manufacturer; and full information sharing. Counter-intuitively, the second mode of information sharing resulted in the highest total supply chain cost compared to other modes, even that of no information sharing. The lowest total cost was gained in the full sharing mode. Note that not all firms benefited from information sharing. The next question is which partners in each stage should be involved and what factors affect that decision. Huang and Gangopadhyay [14] studied various degree of information sharing in a four-stage supply chain comprising customers, retailers, distributors, wholesalers, and manufactures, in which each stage comprises several players. Three scenarios are analyzed: no information sharing; partial information sharing (only 50% of trading partners in each channel involved); and full information sharing. The simulation study found that increasing degree of information sharing resulted in decreased inventory levels at wholesalers. The benefits are higher when demand is highly variable. The study concluded that parties obtain different benefits from information sharing.

The study of related literature shows that information sharing can be beneficial in at least some circumstances. However, the question of which partners should be recruited and recruitment criteria remain unclear. Partner selection in supply chains involves complex processes ranging from strategic to operational. Companies must evaluate their partnering orientation which is the pattern of shared values and beliefs between partnering companies.

Various enablers are associated in acquiring, retaining, and enhancing the competitive strength of the enterprise. Many of such enablers are the result of right practices, policies and consistent performance for certain period of time. It has been reported by several authors [4,6,11]; that sharing of right information at right time has close relationship with the supply chain performance on which the performance of an enterprise lies.

Advances in information technology have changed modern business practice, making collaborative SCM possible. Information's competitive value is widely heralded. It substitutes for inventory, speeds, new product design, shortens order fulfillment cycles, drives process reengineering, and coordinates SC activities. Information sharing is at the core of collaborative, supply-chain based business models. Dell and Wal-Mart, two companies that depend on information exchange to help diverse members of a supply chain to work together efficiently and effectively. Information sharing allows Wal-Mart to outsource much of its inventory planning to suppliers who become responsible for monitoring inventory levels, planning replenishment, and suggesting new ideas to improve throughout. At Dell, sales information cascades back several tiers to make the entire supply chain more efficient and responsive, enabling Dell to operate with only four days inventory supply. Information-enabled collaboration reduces costs across the

chain while enhancing customer service and value. In this study of information sharing of supply chain major supply chain practices and information aspects also considered. Those points are supply chain planning, JIT production, delivery practices, information quality, information content and information sharing support technologies.

3. Types of information shared

The information in a supply chain can be classified in different ways e.g.: strategic or tactical; logistical; or pertaining to consumers [31]. Lee and Whang [25] discuss various types of shared information and their potential benefits. For example, sharing order status can improve the quality of customer service, reduce payment cycles, and reduce labour cost. Sharing retail sales data can mitigate the bullwhip effect. Huang et al [13] sort information into six categories pertaining to product, process, resource, inventory, order, and planning (see Table 1) and Table 2 lists the types of information considered by various researchers in their studies.

Table 1. Classification of production information (Huang, Lau et al. 2003)

Category	Production Information
Product	Product Structure
Process	Material Lead Time
	Lead Time Variance
	Order Transfer Lead Time
	Process Cost
	Quality
	Shipment
	Set-up Cost
Inventory	Inventory Level
	Holding Cost
	Backlog Cost
	Service Level
Resource	Capacity
	Capacity Variance
Order	Demand
	Demand Variance
	Order Batch Size
	Order Due Date
	Demand Correlation
Planning	Demand Forecast
	Order Schedule
	Forecasting Model
	Time Fence

It is also observed that the value of information sharing depends on several conditions. For example, Simchi-Levi and Zhao [34] showed that demand sharing has no significant benefits for a manufacturer under tight capacity. Lee et al. [28] found that demand information sharing has more value if demand is highly correlated over time, highly variable, or the lead-time is long.

The product's characteristics also affect the value of different kinds of information. Sharing forecasts of demand of products that have high demand variability brings significant benefits [1]. The relationship between trading partners also influences the selection of the type of shared information. For example, sharing production schedules with part suppliers can reduce part inventories without risking stock-outs. Sharing shipping information with logistics agents can improve customer service levels. Information sharing arrangements are dictated by circumstances [29]. Most of the existing studies only analyze the sharing of production information, but other information for example, market and consumer information can be important [31]. Lee and Whang [25] showed that sharing market knowledge can improve promotion planning. Sharing information and close coordination between retailers and manufacturers may facilitate developing new products. The previous studies have analyzed a number of types of shared

information however there is still a critical question that needs more investigation i.e. what information should be shared with supply chain partners that give most benefits?

Table 2. Types of shared information

Shared information	Author(s)
Demand	Bourland et al. (1996), Chen et al. (2000), Huang and Gangopadhyay (2004), Lee and Whang (1999), Lee et al. (2000), Mitra and Chatterjee (2004), Raghunathan (2003), Simchi-Levi and Zhao (2003), Waller et al. (1999), Wang and Seidmann (1995), Xu et al. (2001)
Demand, inventory	Waller et al (1999), Cachon and Fisher (2000), Owen and Levary (2002),
Demand, forecast	Boone et al. (2002), Cachon and Lariviere (2001),
Demand, order	Yu et al. (2001), Yu et al. (2002)
Demand, order, inventory	Lau et al. (2002)
Inventory, order	Chen (1999),
Sales	Croson and Donohoue (2003),
Inventory level, warehouse, consumer information	Kulp et al (2004)

4. Benefits of Information sharing

Numerous studies analyze the value of information sharing in a supply chain and factors that affect the value. The overall objective of information sharing is to achieve efficiency in the whole supply chain. However, it is apparent that different parties obtain different returns from information sharing (see Table 3). Ideally, all members of a supply chain should share the benefits equally but members with monopoly power may obtain most of the benefits. Under intense competitions, savings may flow through to customers.

Table 3. The value of information sharing and its allocation reported in related literature

Author (s)	Benefits and allocation
Lau et al. (2002)	Inventory reduction, Not all partners obtain benefits
Simchi-Levi and Zhao (2003)	Manufacturer gain benefits
Mitra and Catterjee (2004)	Only the supplier gain benefits
Waller et al. (1999)	All parties benefit, Non-sharing partners also gain benefit
Huang and Gangopadhyay (2004)	Not much benefits for retailers
Cachon and Fisher (2000)	Not significant benefits from information sharing
Yu et al. (2001)	Manufacturer gain more benefits
Lee et al (2000)	Only manufacturer benefits
Smaros et al (2003)	Manufacturer gain benefit
Chen et al. (2000)	Reduce but not eliminate the bullwhip effect
Bourland et al (1996)	Supplier gains more benefits

The unbalanced benefits of information sharing can discourage information sharing. Most studies on the value of information sharing suggest that companies who gain most benefits give their trading partners incentives in various forms such as lower wholesale prices, flexible payment terms, etc [3]. Though there are few studies investigating how to align benefits between parties there is a strong need for more investigation on how to share the benefits of information sharing amongst partners.

5. Challenges in supply chain information sharing

In view of the diverse business activities, today's supply chain process is very critical for success in current business scenario. Today, the supply chain managers are facing various external challenges driven by customer. The IT-enablement of supply chains is not an easy task. Many researchers have observed that some barriers slow down the process of IT enablement of a supply chain. Therefore, it is important to identify these barriers and develop strategies to tackle these and Table 4 provides a list of barriers identified by various researchers.

Table 4. Barriers in information sharing in supply chains reported in the literature

Author(s)	Barriers identified
Shaw (2000), Jharkharia and Shankar (2000), Warren. and Hutchinson (2000)	Threats of information security, security and access privileges, unauthorized access and tampering of information by the competitors, cyber attacks
Lee and Whang (2000), Monczka and Morgan (1997), Bender (2000), Kilpatrick and Factor (2000), Khurana et al. (2011)	Poor IT infrastructure & Lack of Technology
Bender (2000)	Lack of commitment by top management, Lack of strategic planning
Kilpatrick and Factor (2000)	
Lee and Whang (2000)	
Cox (1999)	Disparity in technological capability among partners
Kadambi (2000).	Fear of information system breakdown
Sohal et al. (2001), Kwan (1999), Khurana et al. (2011)	Financial constraints
LaLonde (2000).	Unwieldiness to transfer the information, Lack of knowledge and awareness about information system in supply chain
Cetindamar et al. (2005)	Lack of trust among the supply chain partners, Lack of trust in supply chain linkage
Mentzer et al. (2000),	Lack of supply chain vision/understanding, Unwilling to share risk and reward
Bowersox et al. (2003)	Poor Inter origination information system
Mohr and Spekman (1994)	Fear of authority loss due to better IT enabled SC M system.

Shaw [33] has noted that security and access privileges are the two most important barriers in implementing internet and extranet technologies in supply chain. Further, unauthorized access and tampering of information by the competitors may lead to disasters [16]. In this regard, Warren and Hutchinson have discussed the various forms of cyber attacks against supply chain management systems. These authors have advised that companies should consider the security aspects while using IT tools in their supply chain. Further implementation of a cross-organizational information system is costly, time-consuming and risky. Supply chain partners also may not agree on the adoption and specifications of the technical system to be used in a supply chain, e.g. EDI standards . Some other researchers [32,2] have termed poor IT infrastructure as a barrier in the supply chain integration. However, poor IT infrastructure may be attributed to lack of funds [2,19], and lack of awareness and commitment of top management about use of IT tools in a supply chain.

IT- enablement may not be considered as the remedy of all supply chain related problems. The success of IT-enabled supply chain lies in the willingness of partner companies to share information for their mutual benefits. Still, many companies are reluctant to share information r with their trading partners [25].

This reluctance again acts as a barrier in the IT- enablement of a supply chain. As the IT enablement of a supply chain is a strategic and capital-intensive issue, mutual trust for long-term relationship and confidentiality of information are the important issue in the IT-enabled supply chain environment.

Further, to communicate electronically in a supply chain trading partners must have compatible IT tools. However, disparities of supply chain organizations with respect to size and policies may inhibit the process of IT-enabled supply chain integration [8]. In a survey of Indian manufacturing companies, Kadambi [17] has also reported weak infrastructure outside the organization and small size of the trading partners as the inhibitors in the IT-enablement of the supply chains. Sohal [35] and Kwan [21] have identified financial factors and lack of compatibility of partners as the barriers in the IT-enablement of manufacturing companies. Further, IT-enablement causes change in work culture and nature of work of some of the employees. Sometimes the organizational hierarchy needs to be changed. These situations result in some resistance from the employees [24]. Lack of willingness to transfer the information is also one of the major challenges. Many industries are not having the enough qualified and trained persons for information sharing. The crucial barriers found in the study [18] are financial, technological and organizational barriers for integration of information sharing with supply chain in the Indian manufacturing industry. Financial constraint is another major barrier in the Indian manufacturing industries.

6. Conclusion

This paper has presented a number of existing studies on information sharing in supply chains. Many investigations on the impacts of information sharing have been carried out under different circumstances and assumptions. This literature review provides the status of the supply chain information sharing in the supply chain management. However, it should be noted that while sharing information is crucial, its impact on the performance of a supply chain depends on what type of information is shared, how it is shared, and with whom. Thus, managers and executives need to give serious thought to adopt a policy of information sharing in their way to SCM implementation and to enhance the particular competitive strengths of the enterprise.

References

[1] Angulo, A., Nachtmann.H et al. (2004). Supply Chain Information Sharing in a Vendor Managed Inventory Partnership. *Journal of Business Logistics* 2004; 25: 101-120.

[2] Bender, P.S. Debunking five supply chain myths. *Supply Chain management Review*, 2000; 4: 52-58.

[3] Bourland, K. E., Powell.S.G, et al. Exploiting Timely Demand Information to Reduce Inventories. *European Journal of Operational Research*; 1996; 92: 239-253.

[4] Cachon, G.P. and Fisher, M. Supply chain inventory management and value of shared information. *Management Science* 2000;46: 1032- 48.

[5] Chen, F. Decentralized Supply Chains Subject to Information Delays. *Management Science*, 1999; 45: 1076-1090.

[6] Clark, T, Hammond, J. Reengineering channel reordering processes to improve total supply chain Performance. *Production Operations Management*, 1996; 6: 248-65.

[7] Cooper, M. C., D. M. Lambert.D.M.'Supply Chain Management: More Than a New Name for Logistics. *The International Journal of Logistics Management*. 1997;8:1-14.

[8] Cox, A .Power, value and supply chain management. *Supply Chain Management: An International Journal*1999;4 :167-75.

[9] D'Amours, S.,Montreuil.B, Networked Manufacturing: The Impact of Information Sharing. *International Journal of Production Economics,* 1999; 58: 63-79.

[10] Gavirneni, S. 'Information Flows in Capacitated Supply Chains with Fixed Ordering Costs. *Management Science* 2002; 48: 644-651.

[11] Hamel, G. Prahalad, C.K. The core competence of the corporation. *Harvard Business Review* 1990; 68: 79-91.

[12] Handfield, R.B, Bechtel, C. The role of trust and relationship structure in improving supply chain responsiveness. *Industrial Marketing Management*, 2002; 31: 367-82.

[13] Huang, G. Q, Lau.J.S.K. The Impact of Sharing Production Information on Supply Chain Dynamics: A Review of the Literature. *International journal of Production Research* 2003; 41:1483-1517.

[14] Huang, Z, Gangopadhyay.A.'A Simulation Study of Supply Chain Management to Measure the Impact of Information Sharing. *Information Resources Management Journal* 2004; 17 : 20-32.

[15] Hult, G.T.M, Ketchen, D.J. ,Slater, S.F.Information processing, knowledge development, and strategic supply chain Performance.*Academy of Management Journal* 2004; 47: 241-54.

[16] Jharkharia, S, Shankar.R .Information technology: a competitive weapon in supply chain management. *Proceedings of International Conference on Flexible system management;*17-20 December, New Delhi: 2000,p 599-610.

[17] Kadambi, B. IT-Enabled supply chain management: a preliminary study of few manufacturing companies in India. Available at: http://www.xlri.ac.in/cltm/LogistiX-2-2000.htm

[18] M.K. Khurana,, Mishra.P.K, Singh.A.R. Barriers to Information Sharing in Supply Chain of Manufacturing Industries. *International Journal of Manufacturing Systems* 2011;1:9-29.

[19] Kilpatrick,J , Factor,R . Logistics in Canda survey: tracking year 2000 supply chain issues and trends. *Material Management and Distribution* 2000; 45:16-20.

[20] Kulp, S.C., Lee, H.L. Ofek, E. Manufacturer benefits from information integration with retail customers. *Management Science* 2004; 50: 431-44.

[21] Kwan, A. T. W. The use of information technology to enhance supply chain management in the electronics and chemical industries. *Production and Inventory Management Journal*, 3rd quarter,1999: 7–15.

[22] Lambert, D. M, Cooper.M.C.'Supply Chain Management: Implementation Issues and Research Opportunities. *International Journal of Logistics Management* 1998; 9 : 1-19.

[23] Lambert, D. M., Cooper.M.C. Issues in Supply Chain Management. *Industrial Marketing Management* 2000 ; 29: 65-83.

[24] LaLonde, B. J. The gap creep. *Supply Chain Management Review* 2000; 3: 7–9

[25] Lee, H.,Whang, S.. Information sharing in a supply chain.. *International Journal of Manufacturing Technology and Management* 2000;1: 79–93.

[26] Lee, H.L., Padmanabhan, P.,Whang, S. Information distortion in a supply chain; the bullwhip effect. *Management Science*, 1997; 43: 546-58.

[27] Lee, H. L. Creating Value through Supply Chain Integration. *Supply Chain Management Review* 2000; 4: 30-36.

[28] Lee, H.L., So.K.C. The Value of Information Sharing in a Two-Level Supply Chain. *Management Science* 2000; 46:626.

[29] Mentzer, J. T., Min.S. The Nature of Inter firm Partnering in Supply Chain Management. *Journal of Retailing* 2000;76: 549-568.

[30] Mentzer, J. T., DeWitt.W. Defining Supply Chain Management. *Journal of Business Logistics* 2001; 22: 1-25.

[31] Mentzer, J. T. Fundamentals of Supply Chain Management: Twelve Drivers for Competitive Advantage. Thousand Oaks, CA: *Sage Publications*, Inc.2004.

[32] Monczka, R.M, Morgan, J.P. What's wrong with supply chain management?. *Purchasing*, 1997; 16 January.

[33] Shaw,M.J . Information based manufacturing with the web. *The International Journal of flexible Manufacturing System* 2000; 12: 115-29.

[34] Simchi-Levi, D, Zhao.Y The Value of Information Sharing in a Two-Stage Supply Chain with Production Capacity Constraint. *Naval Research Logistics* 2003; 50: 888-916.

[35] Sohal, A. S., Moss, S.,Ng, L.Comparing IT success in manufacturing and service industries. *International Journal of Operations and Production Management* 2001 ;21: 30–45.

[36] Warren,M, Hutchinson,W. Cyber attacks against supply chain management system: a short note. *International Journal of Physical Distribution & Logistics Management*, 2000; 30: 710-16.